Claims

1. (previously presented) A method for managing alternate site switching in an optical communication system having a protected end-system in communication with a primary end-system over an optical communication network, the method comprising:

designating at least one backup end-system to back up the primary end-system;

constructing a failover tree through the optical communication system to the at least one backup end-system prior to a detection of a degradation or failure affecting the primary end-system;

forwarding communications from the protected end-system to the primary end-system;

detecting a degradation or failure affecting the primary end-system;

and

upon detection of the degradation or failure affecting the primary end-system, switching traffic from being forwarded by the protected end-system to the primary end-system to being forwarded by the protected end-system to one of said at least one backup end-system using the failover tree,

wherein constructing a failover tree to the at least one backup end-system comprises:

determining a root node for the failover tree; and constructing the failover tree rooted at the root node, and

wherein constructing the failover tree rooted at the root node comprises:

sending a setup request message specifying a failover tree structure to various nodes in the optical communication network;

reserving appropriate lightpath resources by nodes associated with a lightpath to the primary end-system; and

recording the failover tree structure by nodes associated with the failover tree.

2. (original) The method of claim 1, wherein designating at least one backup end-system to back up the primary end-system comprises:

receiving a setup request from the protected end-system specifying the at least one backup end-system.

3. (original) The method of claim 1, wherein designating at least one backup end-system to back up the primary end-system comprises:

automatically discovering the at least one backup end-system using a predetermined auto-discovery mechanism.

4. (cancelled)

5. (previously presented) The method of claim 1, wherein determining a root node for the failover tree comprises:

identifying a candidate node that is within a predetermined distance from the at least one backup end-system;

constructing a shortest-path spanning tree from the candidate node to the at least one backup end-system; and

selecting the candidate node as the root node if-and only if the shortest-path spanning tree does not include any link from the protected end-system to the candidate node.

6. (original) The method of claim 5, wherein identifying a candidate node that is within a predetermined distance from the backup end-system comprises:

using a marking scheme to identify the candidate node.

7. (original) The method of claim 5, wherein identifying a candidate node that is within a predetermined distance from the backup end-system comprises:

solving a geometrical problem to identify the candidate node.

8. (original) The method of claim 5, wherein constructing a shortest-path spanning tree from the candidate node to the at least one backup end-system comprises:

constructing the shortest-path spanning tree from the candidate node to the at least one backup end-system based upon topology information obtained from a routing protocol.

9. (cancelled)

10. (original) The method of claim 1, wherein detecting a degradation or failure affecting the primary end-system comprises at least one of:

monitoring a bearer channel between the primary end-system and a corresponding edge node in the optical communication network; and

querying the primary end-system by an optical-service agent in said corresponding edge node.

11. (original) The method of claim 1, wherein switching traffic from the primary end-system to one of said at least one backup end-systems comprises:

determining a failover node along the failover tree in the optical communication network;

establishing a backup lightpath from the failover node to a backup end-system; and switching traffic to the backup lightpath by the failover node.

12. (original) The method of claim 11, wherein determining a failover node along the failover tree in the optical communication network comprises:

propagating a release message upstream from a primary edge node associated with the primary end-system toward a predetermined root node of the failover tree;

receiving the release message by an intermediate node between the predetermined root node and the primary end-system; and

determining by said intermediate node that the intermediate node supports a backup end-system.

13. (original) The method of claim 11, wherein establishing a backup lightpath from the failover node to a backup end-system comprises:

sending a lightpath setup request message by the failover node downstream toward the backup end-system; and

reserving appropriate lightpath resources by a number of nodes between the failover node and the backup end-system.

14. (original) The method of claim 11, wherein switching traffic to the backup lightpath by the failover node comprises:

sending a connect message by a backup edge node associated with the backup end-system to the failover node; and

switching traffic to the backup lightpath by the .failover node upon receiving said connect message.

15. (original) The method of claim 11, further comprising:

relinquishing lightpath resources by a number of nodes from the failover node to the primary end-system.

16. (original) The method of claim 1, further comprising:

determining that the primary end-system is available; and switching traffic back to the primary end-system.

17. (original) The method of claim 1, further comprising:

determining that the primary end-system is available; and designating the primary end-system to back up the backup end-system.

18. (cancelled)

19. (previously presented) The apparatus of claim 24 wherein the backup end-system designation logic is operably coupled to receive the setup request from the protected end-system specifying the at least one backup end-system.

20. (previously presented) The apparatus of claim 24 wherein the backup end-system designation logic is operably coupled to automatically discover the at least one backup end-system using a predetermined auto-discovery mechanism.

21. (cancelled)

22. (previously presented) The apparatus of claim 24 wherein the failover tree construction logic is operably coupled to determine a root node for the failover tree by identifying a candidate node

that is within a predetermined distance from the at least one backup end-system, constructing a shortest-path spanning tree from the candidate node to the at least one backup end-system, and selecting the candidate node as the root node if and only if the shortest-path spanning tree does not include any link from the protected end-system to the candidate node.

23. (previously presented) The apparatus of claim 22, wherein the failover tree construction logic uses a marking scheme to identify the candidate node.

24. (previously presented) Apparatus comprising:

a device for managing alternate site switching in an optical communication system having a protected end-system in communication with a primary end-system over an optical communication network, including: backup end-system designation logic operably coupled to designate at least one backup end-system to back up the primary end-system; and failover tree construction logic operably coupled to construct a failover tree to the at least one backup end-system prior to detection of actual failure or degradation of the primary end-system, wherein the failover tree construction logic is operably coupled to determine a root node for the failover tree and construct the failover tree rooted at the root node, and wherein the failover tree construction logic is operably coupled to construct the failover tree rooted at the root node by sending a setup request message specifying a failover tree structure to various nodes in the optical communication network, wherein the failover tree construction logic solves a geometrical problem to identify the candidate node, wherein the failover tree construction logic is operably coupled to determine a root node for the failover tree by identifying a candidate node that is within a predetermined distance from the at least one backup end-system, constructing a shortest-path spanning tree from the candidate node to the at least one backup end-system, and selecting the candidate node as the root node if and only if the shortest-path spanning tree does not include any link from the protected end-system to the candidate node.

25. (previously presented) The apparatus of claim 22, wherein the failover tree construction logic constructs the shortest-path spanning tree from the candidate node to the at least one backup end-system based upon topology information obtained from a routing protocol.

26. (cancelled)

27. (cancelled)

28. (cancelled)

29. (cancelled)

30. (cancelled)

31. (cancelled)

32. (cancelled)

33. (cancelled)

34. (cancelled)

35. (cancelled)

36. (cancelled)

37. (cancelled)

38. (previously presented) Apparatus comprising:

an optical communication system for managing alternate site switching, the optical communication system comprising a plurality of end-systems including a protected end-system, a primary end-system, and at least one backup end-system coupled over an optical communication network, wherein each end-system interfaces with the optical communication network through a corresponding optical edge node, and wherein a failover tree is constructed to the at least one backup end-system prior to a detection of a failure of the primary end-system,

and traffic is switched from the primary end-system to a backup end-system upon detecting a degradation or failure affecting the primary end-system; wherein the optical edge node associated with the primary end-system is operably coupled to: detect a degradation or failure affecting the primary end-system; and send a release message upstream toward a root node of the failover tree upon detecting a degradation or failure affecting the primary end-system;

wherein the protected end-system is operably coupled to send a setup request message to its corresponding optical edge node indicating the at least one backup end-system;

wherein the optical edge node corresponding to the protected end-system is operably coupled to construct the failover tree to the backup end-system;

wherein the optical edge node corresponding to the protected end-system is operably coupled to determine a root node for the failover tree and construct the failover tree rooted at the root node; and

wherein the optical edge node corresponding to the protected end-system is operably coupled to send a setup request message specifying a failover tree structure to various nodes in the optical communication network.

39. (previously presented) The apparatus of claim 38, wherein nodes associated with a primary lightpath to the primary end-system are operably coupled to reserve appropriate lightpath resources for the primary lightpath to the primary end-system.

40. (previously presented) The apparatus of claim 38, wherein nodes associated with the failover tree are operably coupled to record the failover tree structure.

41. (cancelled)

42. (cancelled)

43. (cancelled)

44. (cancelled)

45. (cancelled)

46. (cancelled)

47. (cancelled)